




AGRITECTURE

Envisioning CEA over the next 40 years



 Henry Gordon-Smith

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 @TheAgritect

# Presentation Agenda

1. Who is Henry, what is Agritecture, and what is happening in CEA today?
2. Introduction and methodology
3. Scenario analysis for 3 horizons
4. Key takeaways for CEA in NZ



# Introduction





**AgTech  
Speaker**



**Global Nomad**

# WHO IS HENRY GORDON-SMITH?



**Dedicated  
Consultant**

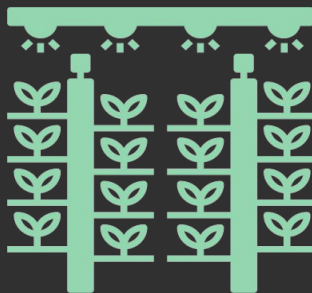


**Team  
Leader**

# ABOUT AGRITECTURE



**Agritecture.com** was founded as a blog in 2011. Ever since, our weekly content has aimed to discover new forms of urban agriculture and share them with the world in order to inspire a new generation of *'agritects'*.



**Agritecture Consulting** was founded in 2014. Through feasibility studies and a variety of other service offerings, we provide our clients with the tools, data, knowledge, and network to ensure their success.



**Agritecture Designer** was founded in 2020. Our software helps overwhelmed urban agricultural entrepreneurs to build out their models, plan crop selection, and create financial plans in partnership with equipment providers.

# THINKING GLOBALLY, ACTING LOCALLY

## Portfolio of Work

200+  
clients

40+  
countries

80+  
cities



## Our Services



Concept  
Development



Farm Design



Investor Due  
Diligence



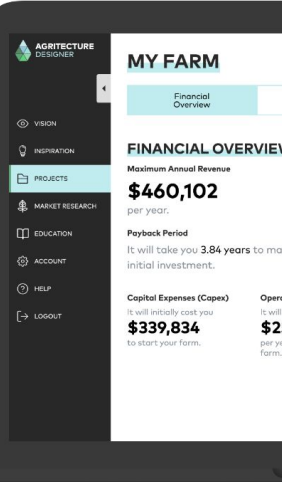
Market  
Research



Local Food  
System  
Planning



Support &  
Management



2014

**1st** Urban AgTech consulting firm in the world

2015

Conducted **1st-ever** broadscale Urban AgTech Workshops across the US

2016

Provided consultancy to *Square Roots*, the world's **1st** vertical farming accelerator

2017

Designed Manhattan's *FarmOne*, the **1st** commercial vertical farm in NYC

2018

Expanded NYC's **1st** sustainable urban AgTech Coworking Lab (AgTech X)

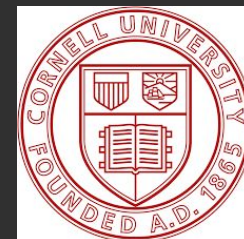
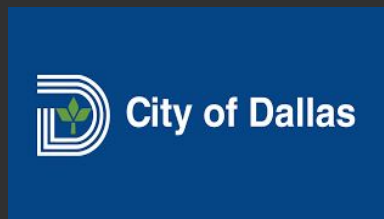
2019

Designed NYC's **1st** AgTech hardware incubator

2020

Launched *Agritecture Designer*, the world's **1st** digital platform for urban Ag planning

# TRUSTED CLIENTS





# Some of Agriculture's Challenges



Climate Change



Greenhouse Gas Emissions



Regulations and Food Quality-Safety



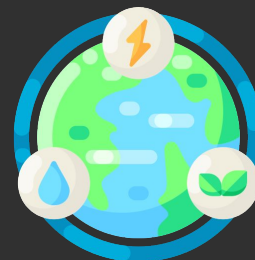
Productivity & Profitability



Food Miles & Waste



Global Uncertainty



Depletion of natural resources

# Controlled Environment Agriculture (CEA)



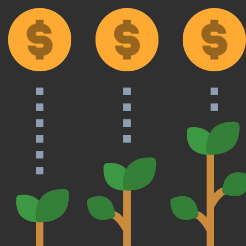
# CEA Advantages



Year-round production



Reduced water usage



Higher crop yields



No pesticides sprayed



Consistent quality and Nutrition security



Local production



Resilience

VS



## Greenhouses



## Vertical Farms

Advantages	Disadvantages
Lower CapEx	Single layer production
Interior system flexibility	High OpEx during winter months
Free sunlight	Less labor efficient at small-medium scale
Lower OpEx	

Advantages	Disadvantages
High density production	High CapEx
Close control over growing environment	High OpEx
High labor use efficiency	High heat output
Ultra-local production	High humidity
	Large carbon footprint

# CEA: Different Models, Different Locations



Gotham Greens:  
New York City, U.S.



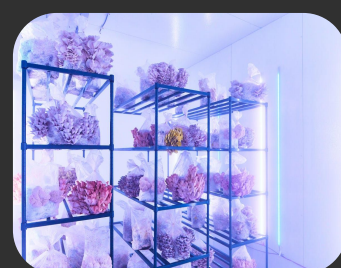
Infarm:  
Worldwide



Appharvest:  
Kentucky, U.S.



NGS: Almeria,  
Spain



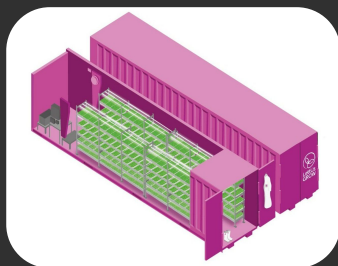
Smallhold: New  
York City, U.S.



Oishii: New  
Jersey, U.S.



HyPar Farms:  
New York, U.S.



LettUs Grow:  
Bristol, U.K.



AquaBounty:  
U.S., Canada



Ynsect: Evry,  
France

# Little Leaf Farms, Massachusetts

*Northeast US Largest Leafy Greens Producer*



# Bustanica, Dubai

*World's Largest Vertical Farm*



Company Name	Type	Challenge	Action	Date	Location	Crunchbase (Total Funding Amount)
InFarm	In-store Vertical Farming Units	Rising Energy Prices	Cut costs and secure path towards profitability	September, 2022	Berlin	\$604.5M
Fifth Season	Robotic Vertical Farming Startup	Recession	Ceasing production	October, 2022	Pittsburgh	\$35M
GlowFarms	Indoor Vertical Farm	Rising Energy Prices	Ceasing production	October, 2022	Netherlands	\$278K
IronOx	Indoor Farm robotics Startup	Refocusing on Technology and Engineering	Focus on their core competence of engineering and technology	November, 2022	California	\$103.2M
AppHarvest	Greenhouse	"substantial doubt" about its ability to continue as a going concern unless it can raise additional outside capital. Stock remains DOA	Announced a new facility	November, 2022	Kentucky	\$646.3M
InFarm	In-store Vertical Farming Units	Rising Energy Prices, Inflation rates, and supply chain disruptions	Strategy shift and to reach profitability	November, 2022	Berlin	\$604.5M
Kalera	Indoor Vertical Farm	Getting de-listed from NASDAQ	Separating from Beever acquisition and others	November, 2022	Florida	\$10M
AquaGreens	Indoor Vertical Farm	Unknown	Went into insolvency	November, 2022	Ontario	\$3M (AGR estimate)

## Lettuce Grown, Money Lost

Energy crisis is currently cited as the biggest issue for the sector but there are underlying challenges before this including high-capex, limited crop varieties, supply chain issues, hype, and improper planning.

## List of Closed Indoor Farms Prior to 2022

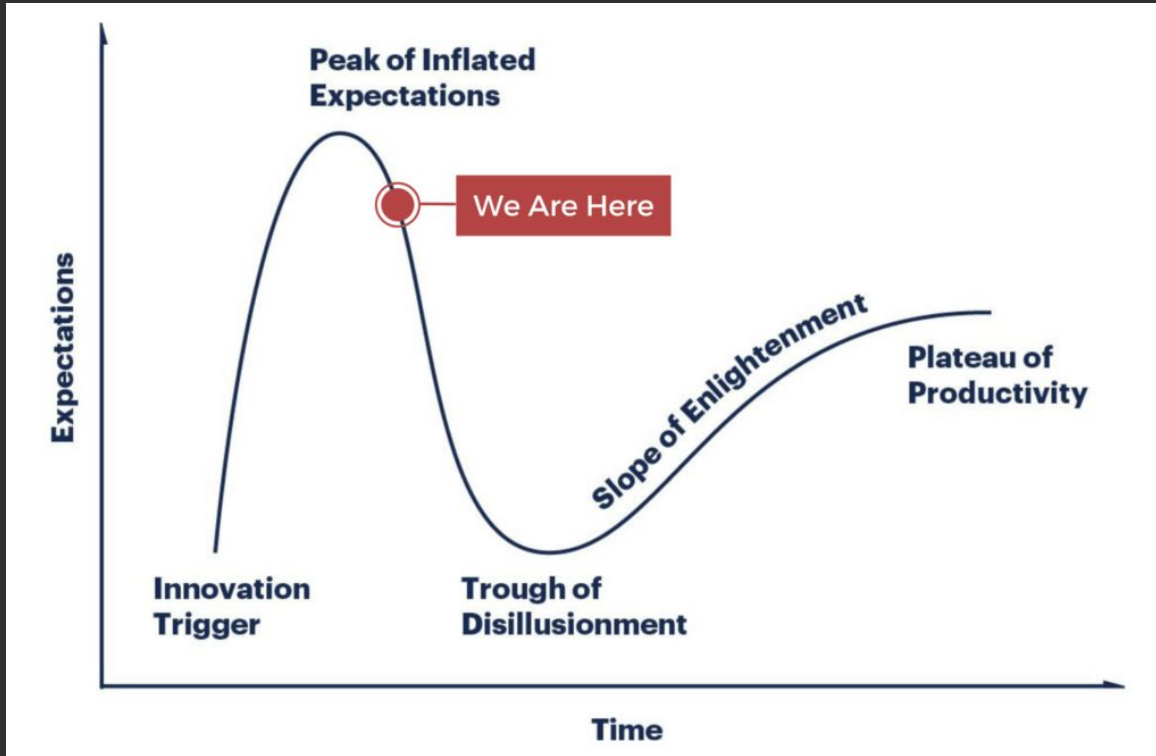
Company Name	Location	Envelope	Product Grown	Method	Reason for Closure
Local Garden	Vancouver, Canada	Rooftop Greenhouse	Leafy greens, microgreens, basil	Carousel + Ebb & Flow	Insufficient lighting design, wrong product choice for market
FarmedHere	Chicago, Illinois	Urban Warehouse	Mixed leafy greens, herbs, and microgreens	DWC	Many technology pivots including to Aquaponics, legal disputes
Metropolis Farms	Philadelphia, PA	Urban Warehouse	Strawberries, leafy greens, and herbs - DWC	DWC	Founder was a scam artist that cheated investors and the city
Podponics	Atlanta, GA	Shipping Containers	Mixed lettuces and leafy greens - NFT	NFT	Failed to maintain a steady revenue plus costs of production
Agricool	Paris, France (and Dubai pilot)	Shipping Containers	Leafy greens, herbs, strawberries -	NFT	Failed Series C investment, Slow execution of Technology Development
Urban Produce	Irvine, CA	Urban Warehouse	Microgreens, wheatgrass, culinary herbs	Station to Station patented NFT	Limited product and bad marketing
Local Roots	Los Angeles, CA	Shipping Containers	Mixed leafy greens and herbs	NFT	Overspend on R&D and unclear business model
Urban Seed	Las Vegas, NV	Desert Greenhouse	Baby Head lettuces and culinary herbs	NFT	Expensive R&D

**This is not the first time that CEA has faced major challenges.**

Many are repeating the same mistakes, not learning from the past.



# This is all part of the journey



“For investors who have held out or spread their risk across the sector, they will see a new industry chapter where mergers and acquisitions occur and a more honest and mature discussion on the present-day realities of CEA emerge. They will see more honest valuations, healthier economics, better-planned facilities, and responsible growth plans.”

-Henry Gordon-Smith  
for AgFunder News in December 2021

How we approached this topic:  
**Methodology**



# CEA HORIZON

## Horizon 1

In the next 1-2 years

Method:

Agriecture & Henry's

- Data
- Experience
- Observations

on the current state of CEA globally and its effects on the next 1-2 years.

## Horizon 2

In the next 2-10 years

Method:

Agriecture's scenario analysis methodology which will be introduced in the next slides

## Horizon 3

In the next 10-40 years

Method:

Building off of Horizon 2, we will look deeper into longer term predictions on

- Energy,
- Water
- Population growth
- Climate change

and hypothesize about what the longer-term future could hold for CEA.

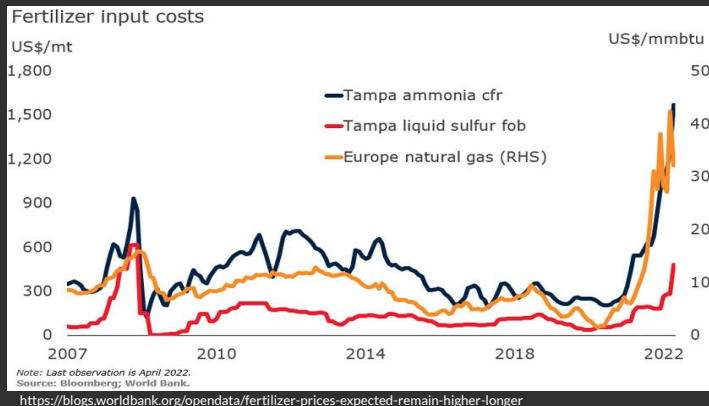


# Horizon 1

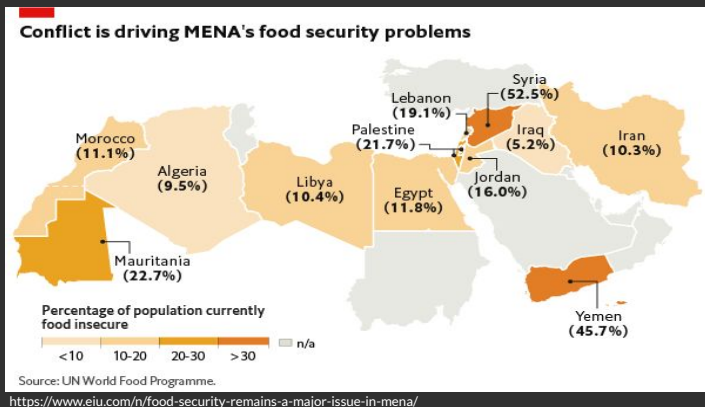
Next 1-2 years



# Climate Change & MENA Focus



- Climate extremes and the skyrocketing cost of **fertilizers** have driven an increasing number of farmers to adopt Controlled Environment Agriculture (CEA), which enables year-round cultivation and water recycling.



- The **MENA** region is investing in Controlled Environment Agriculture (CEA) due to its water scarcity, extreme temperatures, and a growing population's need for food security. CEA provides an opportunity to cultivate crops sustainably, increase yields, and reduce water usage, making it a viable option for the region's agricultural sector.

# Paradoxical Investment & Economics

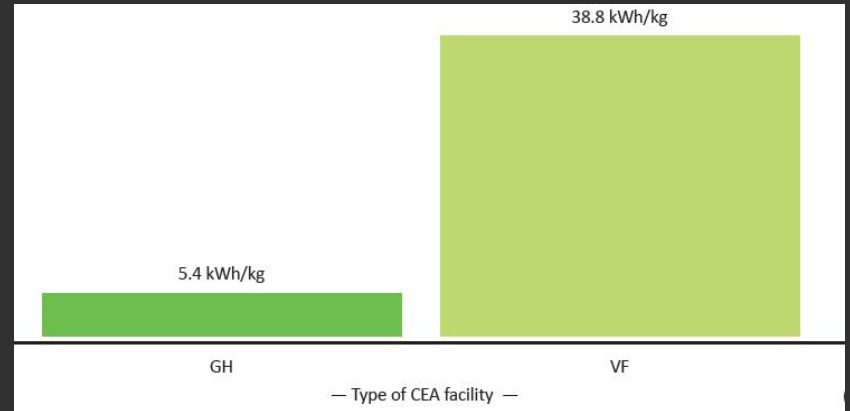
- New and existing CEA companies will gain **investment** while others will fail suddenly. The global vertical farming market size is projected to reach \$12.04B by 2026. The market was worth \$2.13B in 2018 and will exhibit a CAGR of 24.8% during the forecast period, 2019-2026. However, last year saw a 44% drop in Agritech investments from the prior year (AgFunder).

- Vertical farms have significantly higher **energy costs** than greenhouses, leading to higher operational costs and risks.



<https://www.prnewswire.com/news-releases/vertical-farming-market-to-rise-at-24-8-cagr-till-2026-growing-demand-for-efficient-crop-produce-will-contri-bute-to-market-growth-says-fortune-business-insights-300989629.html>

## Amount of energy used (kWh/kg) x CEA Facility Type



2021 Global CEA Census Report

# Food Security Remains Top of Mind

In April 2022 the [World Bank](#) announced that it is making up to \$30B available over a period of 15 months, including \$12B in new projects. The financing is to scale up short- and long-term responses along four themes to boost food and nutrition security, reduce risks, and strengthen food systems:

1. Support producers and consumers
2. Facilitate increased trade in food and trade inputs
3. Support vulnerable households
4. Invest in sustainable food and nutrition security

(World Bank)

The [Global Health Organization](#) suggested on January 2030 the adoption of agricultural technologies to address food insecurity:

- Adoption of agricultural technologies: The use of agricultural technologies can help farmers produce crops more efficiently, reduce waste, meet the rising demand for food and adapt to climate change. It's imperative that small scale producers can access these technologies in order to be more productive, profitable and sustainable.

(Global Health, 2023)



# The Hybridization of CEA

“Greenhouse growers, get 9-15 lettuce cycles per year. The **hybrid** approach is designed to address this issue. It is the unique combination of starting plants in a high-density vertical environment, followed by a transition to greenhouse, that allows to produce 17-30 crop cycles per year.”

- Craig Hurlbert, co-founder of Local Bounti (Vertical Farm Daily)



Agrivoltaics is a hybrid of colocated solar photovoltaic (PV) infrastructure and agriculture.

It involves field farmers adding solar panels on top of their fields and greenhouses.

The overall returns on the crops and the solar photovoltaics (PVs) revenue are both increased. (Agritecture)



# Horizon 2

## Next 2-10 years

For this projection, we must first to introduce you to *Agritecture's* scenario analysis methodology.



A **scenario analysis** is a strategic plan which is built out to generate future trends; for businesses, it is used in building visions and making calculated internal decisions.



# Scenario Analysis Steps

Step 1: Choose a question to be answered

Step 2: Identify Relevant Stakeholders

Step 3: Map Plausible “Turning Points”

Step 4: Identify Key Uncertainties

Step 5: Assess and reduce turning points

Step 6: Define Your Scenarios

Step 7: Map out Scenario

Step 8: Identify Research Needs

Step 9: Results & Recommendations



Step 1:

Choose a question to be answered



## Question:

How will CEA look 10 years from now?



## Step 2:

# Identify Relevant Stakeholders





## Step 3:

Map Plausible “Turning Points”





The **STEEP** method: **S**ocial  
**T**echnological  
**E**conomic  
**E**nvironmental  
**P**olitical



## **Social:**

Demographics, urbanization, culture, consumer behavior, inequality, health and wellness.

## **Technological:**

Technological advancements, automation, digitalization, Research and Development, adoption rates.

## **Economic:**

Job availability, international trade, subsidies, inflation, market competition, investment trends, business regulations, entrepreneurship, infrastructure, energy prices.

## **Environmental:**

Natural resource considerations, climate change shocks, pollution levels, sustainability practices, renewable energy, carbon footprint, biodiversity, waste management, environmental policies, water scarcity.

## **Political:**

Impact from shifts of power, political stability, government regulations, trade agreements, international conflicts, lobbying.



Step 4:  
Identify Key Uncertainties



# Predictable

Unimportant

+ More universities conduct research on CEA

+ Political stability

+ Building CEA in other planets to produce food

- Vertical farming reaches bottom of trough of disillusionment
- + Food safety & supply issues
  - + Costs of climate change on open field farming become more frequent and costly
  - + Energy becomes cheaper
- + Population growth
  - + Urbanization
  - + Vertical farming reaches plateau of enlightenment
- + Additional Environmental Costs of Agriculture (Carbon tax, Water usage, Regulations)
- + Transition to renewable energy

Important

- + Migration
  - Extreme poverty
- + Shift in consumer preference (local, healthier, eco friendly, etc)

- + CEA usage for more crops
- + Funding for AgTech continues to rise

- Supply system shocks

+ Gene editing for CEA

- World War 3

Unpredictable

## Step 5:

Assess and reduce turning points



1. Relevancy to goal
2. Relevancy to time frame
3. Relevancy to stakeholders
4. Can it be measured effectively?



Predictable

+ Food safety & supply issues worldwide

+ Costs of climate change on open field farming become more frequent and costly

+ Energy becomes cheaper

Unimportant

Important

Unpredictable



Step 6:  
Define Your Scenarios





**Scenario 1:**

Vertical Farming becomes profitable

**Scenario 2:**

Energy becomes renewable and cheap

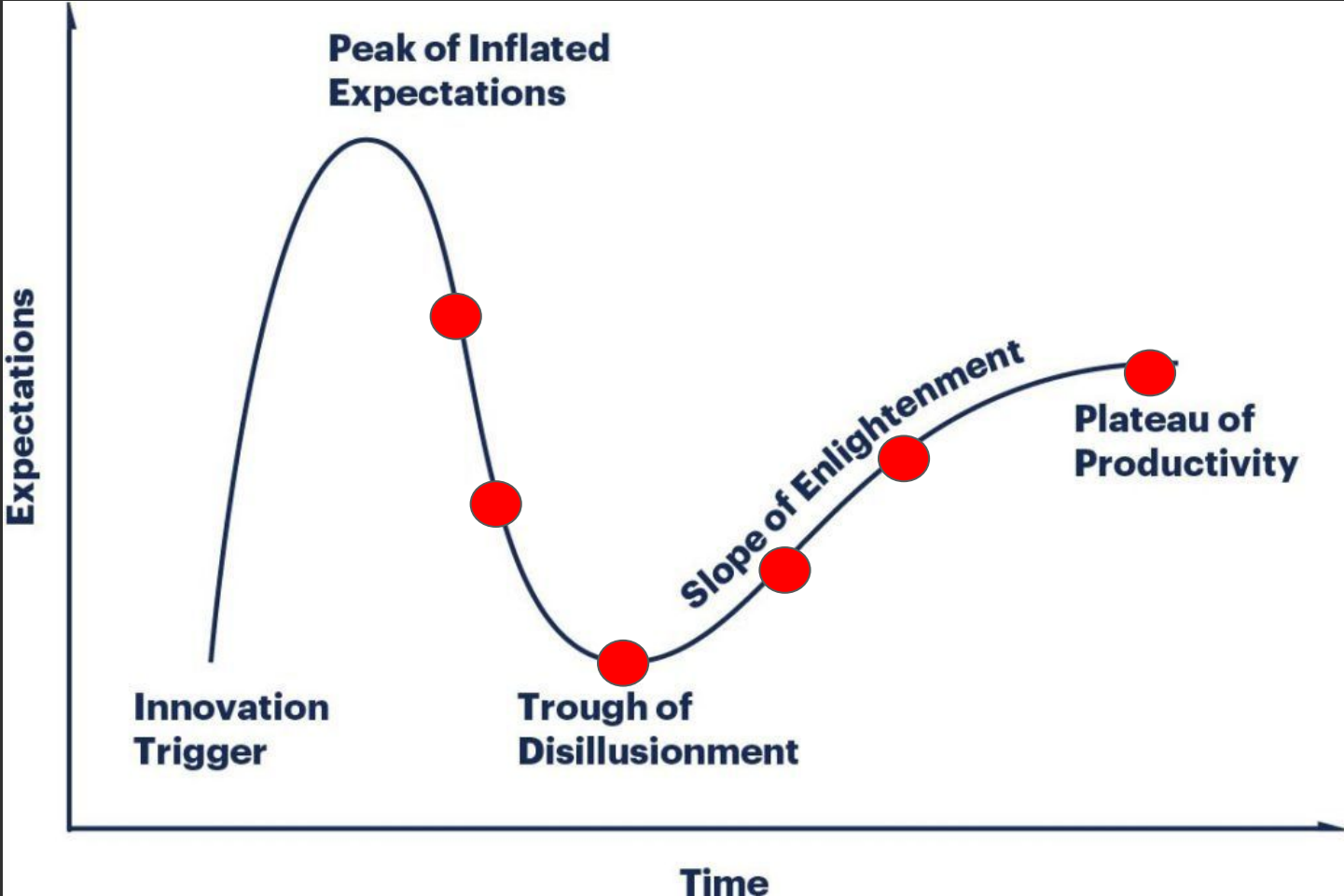
**Scenario 3:**

Unexpected shocks increasing the value of resilience



Step 7:  
Map out Scenario





2023

Vertical farming declines into trough of disillusionment accelerates

2025

Several of the largest VF companies go out of business

2027

Climate Change causes more significant crop losses

2029

Berries become a common commercial high tech CEA product

2031

Energy becomes dramatically cheaper

2033

Vertical farming and localized CEA is being recognized worldwide as a profitable & sustainable method of crop production, leading to a new wave of investment, policy, and business support.

Step 8:  
Identify Research Needs



- **What assumptions need to be clarified?**
- **What sources would help you fill in knowledge gaps?**
- **What existing research exists related to your scenario?**



# But what if...?

## Meet the Two Biggest Enemies of Indoor Farming

BY NIKO SIMOS & HENRY GORDON-SMITH | DECEMBER 12, 2022



Step 9:

# Results & Recommendations



# Recommendations

1	2	3	4	5
Smart energy subsidies	Accelerate CEA entrepreneurs now	Develop responsible urban agriculture policies	Empower existing farmers to embrace CEA	Punish bad-actors over-hyping themselves & greenwashing





# Horizon 3

Next 10-40 years



# Research:

- By 2050, it's projected that 68% of the **world's population** will live in urban areas (an increase from 54% in 2016). In fact, by 2050 there are very few countries where rural shares are expected to be higher than urban.  
Source: <https://ourworldindata.org/urbanization#:~:text=By%202050%2C%20it's%20projected%20that,to%20be%20higher%20than%20urban.>
- Now, 90% of the world's economies have **Net Zero targets** and hundreds of corporates are making the same commitment.  
Source: <https://www.weforum.org/agenda/2022/09/unleashing-the-advertising-industry-s-superpower-to-drive-demand-for-low-carbon-lifestyles/>
- Maize and soybeans are anticipated to benefit the most from **CRISPR** technology - gene editing  
Source: <https://www.sciencedirect.com/science/article/pii/S2589004222012846>
- By 2050, **cultivated meat, plant based-meat, high-protein insects, seaweed and algae, and allergen-free nuts, aquaponics** will be the most sustainable protein sources to support an increasingly growing population.  
Source: <https://steakholderfoods.com/the-does-the-future-of-food-look-like-in-2050/>
- Without meat and dairy consumption, global farmland use could be reduced by more than 75% - an area equivalent to the US, China, European Union and Australia combined - and still feed the world .  
The new analysis shows that while meat and dairy provide just 18% of calories and 37% of protein, it uses the vast majority - 83% - of farmland and produces 60% of agriculture's greenhouse gas emissions.  
Source: <https://www.theguardian.com/environment/2018/may/31/avoiding-meat-and-dairy-is-single-biggest-way-to-reduce-your-impact-on-earth>
- If current climate change trends continue, the results will be a **24% decrease in Corn yields** and a **17% increase in Wheat yields** worldwide by the end of this century  
Source: <https://www.linkedin.com/company/nasa/>
- We need to prevent agriculture for expanding to **save an area of forests nearly 2x the size of India**  
Consumption of ruminant meat (beef, lamb and goat) is projected to rise 88 percent between 2010 and 2050.  
Source: <https://www.wri.org/insights/how-sustainably-feed-10-billion-people-2050-21-charts>

# Predictable

+Today's Farmers are not  
alive, new farmers prefer  
HighTech Farming

+Extreme Water scarcity

+Food prices skyrocket

+68% of the world's population will  
live in urban areas

+Climate Change causing crop damages  
worldwide, causing open field farming not  
effective

+Insects, algae and seaweed becomes world's  
sustainable source of protein

-World War 3

# Unimportant

# Important

# Unpredictable



Climate change worsens and causes widespread droughts, floods, and extreme weather events. Water crisis accelerating and rising to the forefront of global politics. Ongoing conflicts are pushing societies to be more insular.

2033



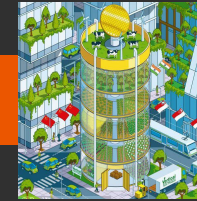
2053



2043

The world's population continues to grow, putting increasing pressure on food production systems. Controlled environment agriculture becomes a key solution for feeding a rapidly expanding global population.

Population begins to decrease but new disease outbreaks that devastate crops and cause food prices to skyrocket, prompting governments and investors to pour resources into controlled environment agriculture to secure food supplies. Water scarcity widespread which also drives more CEA development.



2063

Fully autonomous vertical farms for sale as turnkey solutions - working with 100% robots and producing vegetables, fruits and (in some rare cases even grains). Gene editing combined with CEA presents promising economic and food security solutions. Most of CEA powered by renewable energy or waste energy.



# Key Takeaways for CEA in NZ

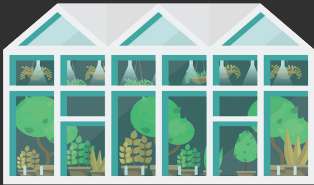


CEA is becoming increasingly popular as more importance is placed on the idea of buying **local, nutritious and fresh**.

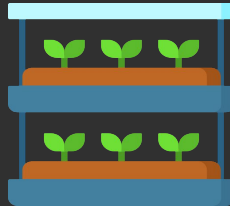
CEA make the **community** much more localised, so could actually reduce traffic by having more activities in the local area, which I know is also a problem in Auckland.

Vertical Farms can grow a lot more yield per square foot close to the consumer **all year round without** the usage of pesticides and herbicides.

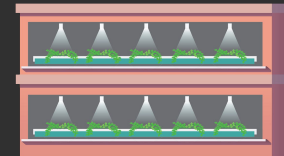
Vertical Farms can save at least **70% of water**. This is important in a future where there's going to be a lot more water scarcity.



High-tech Greenhouses



Microfarms



Large Vertical Farms



- **Where do I start from?**
- **What is the initial cost for a CEA operation in New Zealand?**
- **How big should it be?**
- **What is the operating cost for a CEA operation?**
- **How much yield am I going to produce?**
- **Where should I buy the equipment from?**

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**AGRITECTURE DESIGNER**

# Agriitecture Designer

Introducing the first digital platform to accelerate CEA projects around the world

The screenshot displays the 'AGRIITECHURE DESIGNER BETA' web application. On the left is a dark sidebar with navigation options: VISION, INSPIRATION, EDUCATION, PROJECTS (highlighted), MARKET RESEARCH, HELP, ENGLISH, ACCOUNT, and LOGOUT. The main content area is titled 'PROJECTS' and features a 'COMPARE MULTIPLE PROJECTS' button in the top right. Below this are three filter tabs: 'All Projects', 'In Progress', and 'Completed'. The main area shows a grid of project cards, each with a house icon and a 'VIEW' button. The cards are: 'Mexico City outskirts' (complete, Mon Sep 28 2020), 'Ravi Test Farm' (complete, Wed Apr 22 2020), 'Ricky's New Cool Farm' (complete, Thu Apr 09 2020), and 'Joseph Test Farm' (complete, Mon Apr 27 2020). A dashed box at the bottom center contains a plus sign and the text 'Start a New Project'.

- Farm Modeling Tools
- Crop Pricing Tool
- Commercial Urban Farming Online Courses
- Quotes & discounts from equipment Partners
- ...More to come



# Online Courses!

**COURSE OVERVIEW**

**Henry Gordon-Smith**  
Founder/Managing Director  
Agritecture

6 Lessons 30 Modules 161 Minutes

Commercial Urban Farming Masterclass

**Ian Atkins, PE**  
Application Engineer  
Surna Cultivation Technologies

3 Lessons 8 Modules 116 Minutes

Advanced Lessons

- Work and **Strategies** to Consider When Planning an Urban Farming Business
- **Economics**
- Systems, **Technology**, and Structures
- Understanding Your **Market & Choosing Your Crops**
- CEA **Energy** Considerations: Climate Control Strategies
- HVAC, Yield Predictions, and Genetics
- **Sustainability** Considerations and ESG Reporting

# Agritecture Designer for NZ:

- **Water Price:**  
\$0.00156 (NZD) (including GST) per Litre for all customers.  
(<https://www.watercare.co.nz/>) 2020.
- **Electricity Price:**  
New Zealand, June 2022:  
The price of electricity is 0.188 U.S. Dollar per kWh for households and 0.000 U.S. Dollar for businesses which includes all components of the electricity bill such as the cost of power, distribution and taxes.  
(<https://www.globalpetrolprices.com/>)
- **Average Farm Worker Salary:**  
Average Farm Worker Salary in New Zealand NZ\$49,484  
([https://www.payscale.com/research/NZ/Job=Farm\\_Worker/Salary](https://www.payscale.com/research/NZ/Job=Farm_Worker/Salary))



Countdown Fresh  
Vegetable Spinach

Prepacked 325g  
\$7,29 (NZD)



Fresh Vegetable Kale  
Mixed Red & Green

Prepacked 175g  
\$5,49 (NZD)

Prices sourced from : <https://www.countdown.co.nz/>

# Modelling Tool

## Select your Project


**General**

Project Name


Vertical Farming in New Zealand

Project Location: ⓘ


Wellington, New Zealand




Your operation type: ⓘ



Vertical Farm



Greenhouse



Container Farm

## Select your Area

Site Area (in square meter): ⓘ

10,000

# Select your Crops

## Crops <sup>①</sup>

Crops	Grow System Grow system for your crop (select a crop first)	Percentage of total Fraction of bedspace allocated to crop
Kale	▼ NFT	▼ 50
Spinach	▼ NFT	▼ 50

# Select your Overrides

## Overrides

Override of any default operating costs: <sup>①</sup>

Water cost (\$/liter)

\$ 0.0015

NZD

Water Unit

\$/liter

Electricity cost (\$/kWh)

\$ 0.001

NZD

Tax Rate

30.00

# Get your Results!

## Revenue & Expenses

 \$8,650,011.29

Maximum Annual Revenue

 5.56 years

Payback Period: 5.56 years

It will take you 5.56 years to make a return on your initial investment.

 \$34,651,731.08

Capital Expenses (CapEx)

Initial costs to start your farm

 \$2,347,305.35

Operating Expenses (OpEx + COGS)

Farm operation costs / per year

## Crop Pricing

50% Kale  
\$6.50 / 250 g  
This is a custom price

50% Spinach  
\$4.25 / 1 lb  
This is a default price

## 10-Year Operating Summary

YEAR:	1	5	10
Waste Adjusted Revenue ⓘ	\$8,050,343.4	\$10,894,009.05	\$11,298,443.81
Wastage ⓘ	16.20%	11.11%	7.81%
EBITDA ⓘ	\$5,703,038.05	\$8,546,703.7	\$8,951,138.47
EBITDA Margin	70.84%	78.45%	79.22%
Net Profit ⓘ	\$1,963,045	\$3,953,610.96	\$4,236,714.81
Net Margin	24.38%	36.29%	37.50%

# Choose Your Supplier

## Our Partner Network

We created the Agritecture Partner Network to help you identify the best equipment suppliers for your farm and to provide access to fair financing options. Through the use of this network, you will not only accelerate your time to launch, but you will also save money through available discounts found only through Agritecture.

### Meet The Financing Partners



**HARVEST**  
RETURNS



**FarmRaise**



**MAINVEST**



**perlstreet**

### Meet The Equipment Partners

**MOLEAER**  
ADVANCING NANOBUBBLE TECHNOLOGY

  
**HRVST**

 **MONTEL**  
GROW MORE WITH LESS SPACE™



**New  
Growing  
System**

# Agriitecture Designer Works!



"I found Agriitecture and signed up for your software. I took all the classes then modeled my farm with different crops for 3 months and submitted my farm plan to the government and lenders. Then contacted you and you recommended 4 suppliers"



2500 sqm of vertical farming bedspace growing leafy greens, microgreens, and supplying to restaurants.

**THANK YOU  
LET'S GROW!**



[www.agritecture.com](http://www.agritecture.com)



**AGRITECTURE**